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Helicopter Spraying

For

White Pine Weevil Control

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New Haven, Connecticut

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Aerial Spraying by Helicopter to Control the White-Pine Weevil

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During the past five years large scale experiments in aerial spraying to control the white-pine weevil have been carried out in cooperation with the New York State Conservation Department. In all of these experiments a fixed winged biplane was used to apply the insecticide. The results, in general, have not been satisfactory, although laboratory tests had shown that the insecticides used were toxic to the adult weevil. A number of different insecticides have been tried, but for the most part mixtures containing varying amounts of DDT were used. Both emulsions and solutions of DDT applied with an airplane at the rate of 1 to 4½ pounds per acre gave unsatisfactory results. General field observations made at the time of spray application seemed to indicate that too much of the insecticide was screened out by the pine foliage as it floated down from the airplane, and, therefore, too small an amount of the insecticide was deposited on the bark of the leaders. To correct this condition the spray would have to be forcibly driven down into the upper whorl of branches. This would overcome the screening effect of the foliage, and thus deposit a sufficient amount of the insecticide on the bark of the leader. Preliminary tests with a helicopter in 1949 showed that this type of aircraft would provide such a down draft.

On April 27 and 28, 1950, in cooperation with the New York State Conservation Department, a series of white pine plots were sprayed with a DDT solution using a helicopter for making the application. The helicopter used in this test was a Bell Aircraft 47 B3 equipped with the standard Bell spray boom, pump, and tanks. Forty-two B1 nozzles, 21 on each side of the helicopter, were arranged along the length of the spray

boom. During the test only 38 of the nozzles were required for the maximum output. In order to obtain smaller spray droplets the nozzles were pointed upwards so that the spray was projected into the air blast from the rotor. In future tests, to eliminate the blow-back of the spray onto the spray boom and then falling off as large droplets, the nozzles should be projected rearward and upward instead of forward and upward as they are now arranged on the Bell boom. This would also eliminate the danger of the fine spray particles being blown into the exhaust system and becoming ignited. In flight the helicopter was flown about 10 feet over the tops of the pines at approximately 20-25 m.p.h. This gave an effective swath width of 40 feet. The insecticide, an oil solution of DDT, was applied at the rate of 2 pounds of DDT in 2 gallons of spray solution per acre.

The plantation selected for this test contained approximately 130 acres of white pine, and made up part of Reforestation Area No. 2, Chenango County, Otselic, N.Y. Field checks made in 1949 showed that over 25 percent of the trees had been weeviled during that year. An area having conditions similar to the spray area, but approximately one mile away, was used for the check area. Poor survival in both areas had reduced the original number of trees planted by about 40 percent. In setting up this study the sprayed area was divided into four blocks of approximate equal size (see attached map). All four of these blocks received the same amount of insecticide per acre, but two of the blocks (Blocks A) were flown over once with the helicopter calibrated for an output of 2 gallons of spray per acre. The remaining two blocks (Blocks B) were flown over twice, the second flight at right angles to the first with the helicopter calibrated for an output of 1 gallon of spray per

acre per flight. This provided two methods of treatment for analysis. Within each of the spray blocks 6 one-half acre sampling plots were randomly located. All data for the analysis of this experiment were obtained from these 24 sampling plots.

In sampling the experimental area three different methods were used to obtain data. The first involved the jarring of the upper whorl of branches on 20 trees selected at random per sample plot, and recording the number of weevils that fell on a sheet held below. This examination was made about 2 weeks after the spray had been applied. An examination was made in the check plot in the same manner. The original plans had called for a similar prespray examination, but unfavorable weather conditions prevented this. The second method involved the checking of every tree within the sampling plots during August and noting those that were currently weeviled. A similar examination was made in the check plot. The third and final method involved the scattering at random of 60 pairs of aluminum plates within each sample plot. These 6" x 12" plates were so arranged that only one side was exposed to the spray. This gave one square foot of exposed surface for each pair of plates, or 60 square feet per sample plot. Twenty pairs of these plates were placed flat on the ground in the open, 20 were placed flat on the ground but directly beneath 20 different trees, and the final 20 pairs were bent to form cylinders which were then hung vertically over the leaders of the 20 trees mentioned above. The first 20 pairs were used to measure the amount of DDT that fell on the plots. The second 20 pairs were used to determine if the down blast of the rotor could penetrate the foliage of the pines and distribute the insecticide on the ground near the base of the tree. The third 20 pairs of plates were used to simulate the leaders

to obtain data on the distribution of spray droplets on a vertical surface. The chemical analysis of these plates was made by the Division of Insecticide Investigations.

On May 11th the first post-spray check was made. No live weevils were found in the sprayed area, while the check plot averaged 2.4 weevils per tree. May 23rd a second check, similar to the above, produced only 5 weevils in the sprayed area, while the check plot averaged 2.9 weevils per tree. In June the sprayed area was again checked, and, although no evidence of weevil feeding could be found in the sprayed area, over 85 percent of the trees in the check plot showed signs of heavy feeding. The final check was made on August 11th and of the 2,240 trees examined in the treated plots only 2 were found to be weeviled during 1950. In the check plot 217 of the 980 trees examined were weeviled. To further check on this excellent control the entire sprayed area was examined, and only 9 additional weeviled trees were found. In a back corner near an adjacent stand of sugar maples a small group of pines were found that had probably been missed during spraying. These pines were badly weeviled, and may provide a source of future infestations. In the future to prevent such misses a swath should be flown entirely around each spray area with the helicopter traveling at a slow rate of speed to take full advantage of the rotor's down blast.

The helicopter was not only successful in dispersing the insecticide, but proved very efficient in its field operation. The ability to fly at any speed even at 0 m.p.h., and to ascend or descend almost vertically makes this type of aircraft extremely valuable. The slower the aircraft travels the more forceful is the down draft from the rotors which, in turn, results in a better penetration of the pine foliage by

the spray droplets. Travel time between spray area and landing field is greatly reduced by the ability of this aircraft to land in any small level opening in or near the area being sprayed. The only requirement is that the landing field be accessible to the tank truck carrying the insecticide. The flight data for this experiment are given in the following table:

Species Sprayed	No. Flights	Approx. Acreage	Gallons DDT	Flight Time (minutes)
White Pine:		130		
Once Over	6		136	51
Twice Over	6		126	85
Norway Spruce	5	70	134	65
Total	17	200	396	201 or 3 hrs. 21 min.

It is unfortunate that deposit data for the fixed winged planes are not available for comparison with the data obtained from this experiment. However, a statistical analysis[1/] of the DDT deposit data from this experiment yielded the following information:

1. There was no significant difference in deposit between the two treatments, i.e. between application by parallel flight lines and criss-cross flight lines.
2. The difference in amount of deposit (DDT in lbs. per acre) on the three plate positions were highly significant; the plates on the ground in the open, the plates on the ground under the tree, and the plates hung vertically on the tree showing highest to lowest deposits respectively. Considerable variation was shown, however, between the deposits on each set of plates.

[1/] The statistical analysis of the spray deposit data was made by W. E. Waters of the New Haven Station.

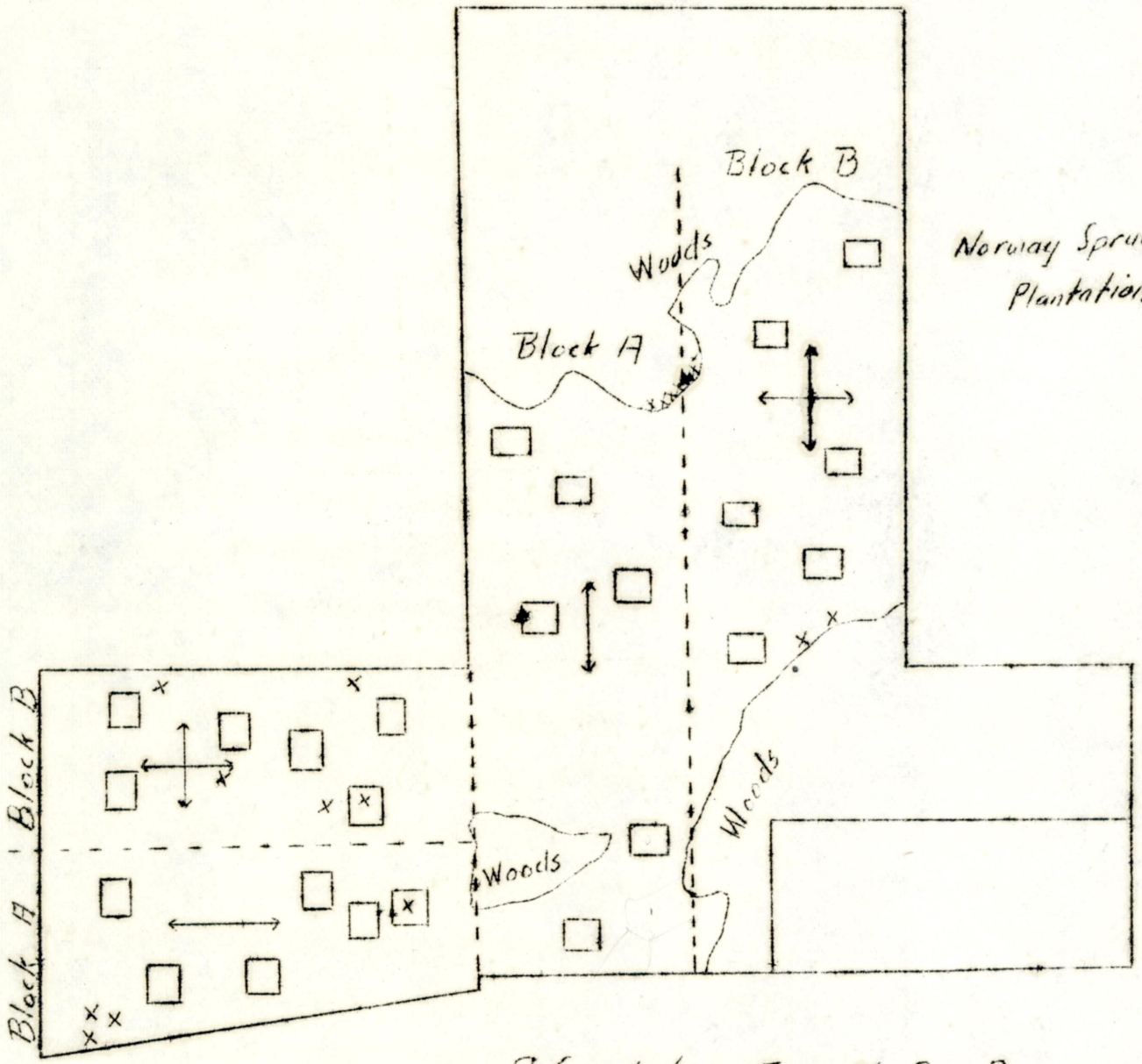
3. Pertinent values for each of the three plate positions are given in the following table. The range shown in column 4 shows extremes which actually were very seldom encountered. For instance, only 4 samples out of 480 showed no deposit.

Plate Position	Mean deposit lbs. DDT/acre	Standard Error of mean	Range in lbs. DDT/acre
On tree	.36	.02	0 - 1.26
Under tree	.51	.03	.04 - 1.76
In open	1.20	.04	.28 - 3.39

The data presented above show that DDT applied with a helicopter at the rate of 2 pounds in 2 gallons of spray solution will give excellent results in controlling the white-pine weevil regardless of method of application or differences in ground conditions. This control is due, mainly, to a better distribution of the spray particles. The rotation of the rotor produces a strong downward blast of air which is sufficient to drive the fine spray particles through the pine foliage and coat the bark of the leader with an adequate amount of the insecticide. The absence of any pre-oviposition feeding within the sprayed area is further evidence of the toxicity of this coating.

In addition to the above sprayed area an adjacent 70 acre plantation of badly weeviled Norway spruce was also treated. The insecticide used was DDT applied by the helicopter at the rate of 2 pounds of DDT in 2 gallons of spray solution per acre. On September 11th this area was checked and of 800 trees examined only 2 were found to be weeviled.

Map of Helicopter Spray Area - Spring, 1950



Reforestation Area No. 2 Pro. V
Chenango Co., Otselic, N.Y.

----- Division between spray blocks
⟷ Helicopter flight lines
□ Sampling Plots
x Location of 1950 weeviled trees
Scale 1" = 10 chains